REMARKS

Applicants acknowledge allowability of Claims 6, 7 and 8 and have rewritten those claims in independent form including all of the limitations of the base claim and any intervening claims. Claims 6, 7 and 8 are thus believed to be in allowable condition. Claims 2 and 3 also were not rejected on the basis of prior art, and as now amended are believed to be in allowable condition.

Reconsideration and removal of the rejection of Claims 1-4 under 35 U.S.C. §112, second paragraph, is respectfully requested in view of he present amendment to Claim 1. As indicated, Claims 1-4 are to a heat sink *per se*, and are now believed to be clear.

Independent Claim 1, as now amended, is to a heat sink for a semiconductor device, that has a base formed of a metallic material having a first surface on which a plurality of heat-radiating fins are arranged, and a second surface arranged to contact a semiconductor device directly. A heat spreader formed of a metallic material which has a heat conductivity higher than that of the metallic material of the base is provided on the second surface of the base and is arranged such that the heat spreader does not contact a semiconductor device directly when a semiconductor device is in contact with the second surface; while Claim 5 is to a semiconductor device comprising a heat sink, where the heat sink has a base with a first surface on which a plurality of heat-radiating fins are arranged, and a second surface which contacts the semiconductor device directly. A heat spreader is provided on the second surface of the base so that the heat spreader does not contact the semiconductor device

directly. Such arrangements of a heat sink for a semiconductor device and semiconductor device are not taught or suggested in the prior art.

In the Office Action, Claims 1 and 4 are rejected as anticipated under 35 USC 102(b) by Krassowski et al. (U.S.- 2003/0116312A1). The Office Action alleges that Krassowski, in Figs. 3 and 5 anticipate the present claims, since the recitation "does not contact the semiconducting device directly" is not deemed to distinguish over that reference.

The Krassowski heat dissipating component, however, is an anistropic planar element that has a relatively high thermal conductivity in the plane of the planar element and a relatively low thermal conductivity in a direction normal to the plane of the planar element. A cavity is present in the planar element that receives a core or insert closely received in the cavity. While the core can be a metal such as copper or aluminum, the planar element is graphite. In the present invention, the base is of a metallic material and the heat spreader is of a metallic material which has a heat conductivity higher than that of the metallic material of the base. Claim 1 has been amended to point out this distinction. Also, in Krassowski, the heat spreader (12, 22) contacts directly the semiconductor device (14) whereas, in the present invention, the heat spreader is arranged such that the heat spreader does not contact the semiconductor directly. Claim 1 has also been amended to better define this relationship.

As discussed in the the present specification, in the case of a conventional heat sink, it is difficult to increase the cooling capacity for a highly heat-producing semiconductor device, such as an LSI, while maintaining the size of the heat sink at a level equivalent to the current size.

According to the heat sink of the present invention, the height of the heat-radiating fins can be reduced without reducing the cooling capacity for the highly heat-producing semiconductor device, such as an LSI, and a lightweight, slim structure of a semiconductor device can be realized. The heat-conduction loss in the contact region between the heat spreader and the base can be reduced when compared with a conventional heat sink and the heat can be efficiently dissipated in the whole heat-radiating fins of the heat sink. Therefore, the heat sink of the present invention can provide an increased cooling capacity for the highly heat-producing semiconductor device.

Krassowski teaches that the heat dissipating component is an anisotropic planar element having a relatively high thermal conductivity in the plane of the planar element and a relatively low thermal conductivity in a direction normal to the plane of the planar element. Krassowski teaches also that the heat spreader (12, 22) contacts directly the semiconductor device (14). Accordingly, Krassowski does not disclose or suggest the present claimed invention having "the heat spreader formed of a metallic material having a heat conductivity higher than that of the metallic material of the base" and "the heat spreader not contacting the semiconductor device directly" as recited in the amended claim 1.

Claim 5 has been rejected under 35 USC 102(b) as anticipated by Ninomiya et al. The Office Action alleges that the reference shows use of a solder bonding layer (6) and a substrate (8) between a copper or other metal layer (9) and the component (7). Thus, the heat spreader does not contact the semiconductor device "directly".

Applicants believe the Office Action has mischaracterized the teachings of Ninomiya. If (1, 2, 3) is considered a base that has fins on a first surface, and a second surface on which (9) is formed (labeled a heat spreader in the Office Action), then if the semiconductor (7) is said to contact the second surface directly, the heat spreader must also contact the semiconductor directly, which is contrary to the present Claim 5. In Claim 5, the second surface contacts the semiconductor directly but the heat spreader does not contact the semiconductor directly.

Thus, Ninomiya does not disclose or suggest the invention of claim 5 where the second surface contacts the semiconductor device directly but the heat spreader does not contact the semiconductor device directly.

In view of the present amendments to the claims, Claims 1-5, as amended, in addition to Claims 6, 7, and 8, are believed to be patentable and early action towards allowance thereof is respectfully requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosure: Petition for Extension of Time

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